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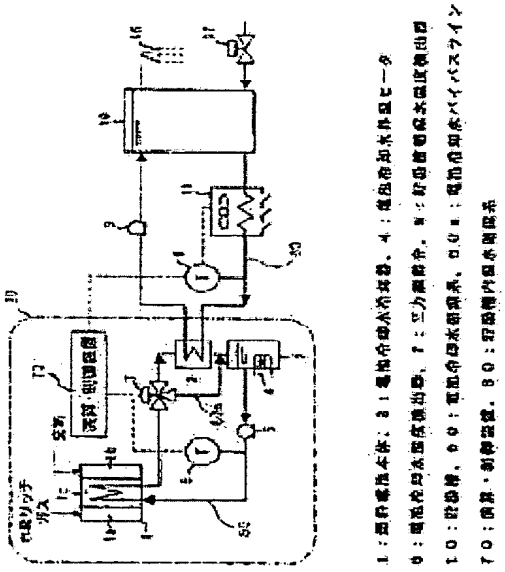
(54) FUEL CELL GENERATOR AND ITS OPERATION METHOD

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a fuel cell generator and its operation method high in economical efficiency, by suppressing the electricity consumption on startup.
SOLUTION: In the operation method of a fuel cell generator which supplies waste heat from fuel cells to a hot water tank 10, a part of thermal energy stored in the hot water tank 10 is used as at least the part of supply heat necessary for fuel cell startup. For implementing the method, when the detected value by a temperature detector of hot water tank circulating water 8 is higher than the detected value by a temperature detector of cell cooling water 6 at the initiating time of the fuel cell 1, a three way adjusting valve 7 is controlled in order to flow cell cooling water to a cell cooling water cooler 2. When lower, the three way adjusting valve 7 is controlled in order to flow the cell cooling water to a cell cooling water bypass line 60a. Furthermore, the fuel cell generator is provided with an operation/control device 70 which operates a cell cooling water warming heater 4 in order to add thermal energy when the lower case and lack of the supply heat necessary for fuel cell startup are happened.



* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1]
In an operating method of a fuel cell power plant which supplies waste heat of a fuel cell to a hot water storage tank as equipment for a waste heat management via battery cooling water,
An operating method of a fuel cell power plant characterized by exploiting a part of thermal energy of supply heat required at the time of starting of said fuel cell stored in said hot water storage tank in part at least.
[Claim 2]
An operating method of a fuel cell power plant performing supply of thermal energy stored in said hot water storage tank in the operating method according to claim 1 by carrying out conduction of the warm water of a hot water storage tank internal temperature water cycle system to a battery-cooling-water condensator formed in the battery-cooling-water circulatory system.
[Claim 3]
In the operating method according to claim 2, detected water temperature of a prescribed position of said hot water storage tank internal temperature water cycle system, When it is when lower than detected water temperature of a prescribed position within the battery-cooling-water circulatory system and supply heat required at the time of starting of said fuel cell runs short, An operating method of a fuel cell power plant working a battery-cooling-water temperature-up heater formed in reboiling ****** or the battery-cooling-water circulatory system of gas with which said hot water storage tank is provided, and supplying thermal energy.
[Claim 4]
A fuel cell body, the battery-cooling-water circulatory system which cools a fuel cell body, and a hot water storage tank as equipment for a waste heat management of a fuel cell body, A hot water storage tank internal temperature water cycle system and a battery-cooling-water condensator which it was provided in said battery-cooling-water circulatory system, and was constituted so that warm water of said hot water storage tank internal temperature water cycle system and heat exchange were possible, A battery-cooling-water temperature-up heater and a battery-cooling-water thermometric element formed in said battery-cooling-water circulatory system, In a fuel cell power plant provided with a battery-cooling-water bypass line and a three-way-type control valve of a hot water storage tank circulating-water-temperature detector formed in said hot water storage tank internal temperature water cycle system, and a battery-cooling-water condensator formed in said battery-cooling-water circulatory system,
At the time of starting of said fuel cell body, when a detection value of said hot water storage tank circulating-water-temperature detector is higher than a detection value of said battery-cooling-water thermometric element, Control said three-way-type control valve to carry out conduction of the battery cooling water to a battery-cooling-water condensator, and when low, When said three-way-type control valve is controlled to switch battery cooling water to a battery-cooling-water bypass line, and it is when [said] low and supply heat required at the time of starting of a fuel cell runs short, A fuel cell power plant having worked said battery-cooling-water temperature-up heater, and having an arithmetic and control unit which supplies thermal energy.
[Claim 5]
A fuel cell power plant comprising:

In the fuel cell power plant according to claim 4, said hot water storage tank internal temperature water cycle system is a three-way-type selector valve to in-and-out piping to a hot water storage tank, respectively.
After said arithmetic and control unit carries out conduction of the warm water of the hot water storage tank upper part to said battery-cooling-water condensator at the time of starting of said fuel cell body, A function which changes said three-way-type selector valve so that it may flow back in the hot water storage tank upper part after adjusting said three-way-type selector valve so that it may flow back in the hot water storage tank lower part, and carrying out conduction of the warm water of the hot water storage tank lower part to said battery-cooling-water condensator conversely at the time of usual operation of a fuel cell.

[Claim 6]
A fuel cell power plant comprising:
Replacing with said battery-cooling-water temperature-up heater in the fuel cell power plant according to claim 4 or 5, said hot water storage tank is reboiling ****** of gas.
A function to work reboiling ****** of said gas and to supply thermal energy when said arithmetic and control unit runs short of supply heat required at the time of starting of said fuel cell body.

[Claim 7]
The fuel cell power plant comprising according to claim 6:
A hot water storage tank bypass line which bypasses said hot water storage tank and supplies warm water which ******(ed) by said reboiling ****** to a user hot water supply port.
A hot-water supply temperature control valve which it was connected to this bypass line and provided on a hot-water-supply supply line to a user hot water supply port of warm water of the hot water storage tank upper part.
A hot-water supply temperature detector formed on said hot-water-supply supply line.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]
This invention relates to the fuel cell power plant provided with the hot water storage tank as equipment for a waste heat management which collects the heat of the cooling water which received from the fuel cell, and its operating method, in order to carry out heat supply of the waste heat of a fuel cell effectively to external heat utilization equipment.
[0002]
[Description of the Prior Art]
Although there are various types which change with an electrolytic kind, kinds of reforming raw material, etc. as a fuel cell built into a fuel cell power plant, For example, the solid polyelectrolyte type fuel cell is well known as a type fuel cell in which the operating temperature is comparatively as low as about 80 **, using solid polymer membrane as an electrolyte.
[0003]
This solid polyelectrolyte type fuel cell hydrogen in the fuel gas produced like the phosphoric acid fuel cell by carrying out steam reforming of the raw materials and mineral fuel, such as methane, and oxygen in the air, It is what supplies the fuel electrode and air pole of a fuel cell, respectively, and generates electricity based on electrochemical reaction, Also in the fuel cell power plant incorporating a solid polyelectrolyte type fuel cell, supply and take out the heat generated at the time of power generation for cooling water, and the temperature of a fuel cell body is maintained uniformly, and generating heat is collected, for example, it is using effectively with the equipment for a waste heat management of the calorifier for a waste heat management, etc.
[0004]
Although the method of facing reforming raw materials and mineral fuel to fuel gas, adding a steam to raw materials and mineral fuel, and promoting refining according to a catalyst with a fuel reformer is taken, It is necessary to supply a necessary water vapor content regularly for performing refining regularly, and to always supply the water corresponding to this to the feed unit of a steam. The water to be used needs to be water of a high grade, and it is usually that the ion exchange water from which the impurity was removed with ionic exchange-type water treatment equipment is used.
[0005]
On the other hand, although power generation produced water arises and combustion produced water arises with the combustion for catalyst heating for performing regularly the steam reforming reaction which is an endoergic reaction in a fuel reformer according to the electrochemical reaction of a fuel cell, These produced water has few impurities compared with the usual tap water, since the load of water treatment equipment is mitigable if these produced water is used as raw water, a recycled water tank and an exhaust gas cooler are added, and the method of collecting these produced water is taken.
[0006]
Drawing 8 is the fundamental distribution diagram of the solid polyelectrolyte type fuel cell power plant provided with the equipment for a waste heat management of this conventional kind which mainly paid its attention to the exhaust-heat-recovery system and the produced water recovery system.

[0007]
In drawing 8, the fuel cell 1 shown typically is constituted by allocating and laminating the cold plate 1c which has a condenser tube or a cooling groove, whenever it piles up two or more unit cells which have the fuel electrode 1a and the air pole 1b.
[0008]
As cooling water of a fuel cell, the pure water which stored liquid on the battery-cooling-water tank 3 is used, by the cell cooling water circulation pump 5, conduction of the battery-cooling-water circulatory system 60 is carried out, and a fuel cell is supplied. In order to cool this, cooling maintenance of the cooling water which came out of the fuel cell is carried out by the battery-cooling-water condensator 2 formed in the battery-cooling-water circulatory system 60, the bypass line 18 which bypasses this, and the three-way-type control valve 7 which adjusts both flow rate at prescribed temperature, for example, 75 **. This adjustment control is performed by adjusting the opening of said three-way-type control valve 7 based on the difference of the output value of the thermometer 6 established in the battery-cooling-water tank 3, and a predetermined temperature setting value.
[0009]
On the other hand, to the battery-cooling-water condensator 2, the recycled water in a fuel cell power plant is supplied, and battery cooling water is cooled to it. The recycled water of the recycled water tank 50 is supplied to the battery-cooling-water condensator 2 with the recycled water pump 51, is taken out by the exterior of a fuel cell power plant package after that, is supplied to the hot water storage tank 10 as equipment for a waste heat management, supplies the waste heat of a fuel cell here, and uses it for hot water supply etc.
[0010]
The hot water temperature in the hot water storage tank 10 is high enough, and when waste heat from a fuel cell cannot finish throwing away here, it cools with the recycled water condensator 53 and the recycled water cooling fan 54 in the lower stream. Then, recycled water is supplied to the exhaust gas cooler 55, carries out direct contact of the exhaust gas from the air pole of a fuel cell, and the combustion gas from the fuel reformer which is not illustrated to recycled water, cools these exhaust gas, and collects produced water. 41 shows exhaust outlet piping and 56 shows recycled water condensator outlet piping.
[0011]
The branch line 46 of the pure water used as the steam for refining is established in the outlet side of the cell cooling water circulation pump 5, and refining service water is regularly supplied to the fuel reformer which is not illustrated from here. Therefore, although it is necessary to always supply the part, this is supplied from the makeup water supply line 57, when it is supplied via the water treatment equipment 58 and recycled water runs short from recycled water.
[0012]
Since the operating temperature of a solid polyelectrolyte type fuel cell is about 80 **, in order to maintain this temperature, the fuel cell outlet temperature of cooling water will also be about 80 **. Since it is necessary to lower the temperature of the recycled water which came out of the recycled water condensator 53 on the other hand in order to collect exhaust gas and to make the makeup water from the outside into zero as much as possible to 45 ** or less, the hot water storage tank inlet temperature of recycled water will be about 50 ** as the result.
[0013]
Next, the example of the conventional system of drawing 7 is described. The system shown in drawing 8 shows the example of a system of a different small capacity polymer electrolyte fuel cell power plant in part, and the system shown in drawing 7 omits and shows some members, after [expedient] this invention explains. In drawing 7, the same number is given to the same function member as the member shown in drawing 8, and the detailed explanation is omitted to it.
[0014]
In recent years, from a viewpoint of new energy policy promotion, development of a small capacity polymer electrolyte fuel cell power plant progresses quickly, and examination installed in a home, a small-scale place of business, etc. is advanced. It is common to generate a line intermediary and an economic merit for the cogeneration which carries out accumulation of about 70 ** warm water

produced along with the time of a small capacity polymer electrolyte fuel cell power plant generating electric power to a hot water storage tank, and carries out hot water supply to a bathroom or a kitchen at these installation places.
[0015]
Within the limits of the dashed dotted line shown by 20 in drawing 7 shows the inside of the package of a small capacity polymer electrolyte fuel cell power plant. Although much apparatus exists in the inside of the package 20 besides the member shown with the parts numbers 1-7, these are omitted here.
[0016]
1 shows a fuel cell body and the generated heat is supplied to the external hot water storage tank 10 by the battery-cooling-water condensator 2 as mentioned above. At this time, the battery-cooling-water flow which passes the battery-cooling-water condensator 2 is suitably adjusted so that it may become the temperature which the fuel cell body's 1 is stable and can operate the detection temperature by the battery-cooling-water thermometric element 6 by the three-way-type control valve 7. Accumulation of the heat supplied outside by the battery-cooling-water condensator 2 is carried out to the hot water storage tank 10 with the hot water storage tank circulating water sent out with the hot water storage tank circulating water pump 9.
[0017]
If the hot water storage tank circulating-water-temperature detector 8 detects that the temperature level of the hot water storage tank 10 reached beyond constant value, the hot water storage tank circulating water condensator 11 will operate, and it will be controlled to be able to perform normally battery-cooling-water temperature control of a fuel cell power plant. After hot water storage tank circulating water is drawn from the lower part of the hot water storage tank 10 and is heated by the battery-cooling-water condensator 2, it serves as a piping configuration supplied to the hot water storage tank upper part. This is for supplying the temperature of the highest possible level to the user hot water supply port 16 which uses the warm water of a hot water storage tank in consideration of the temperature level of the temperature distribution of the warm water by the free convection of hot water storage tank 10 inside, i.e., the upper levels in the hot water storage tank 10, being high.
[0018]
In order to prepare for a power generation start on the other hand at the time of an activation process until a fuel cell power plant results in power generation and to carry out temperature up of the temperature of the fuel cell body 1 to a predetermined temperature, battery cooling water is heated with the battery-cooling-water temperature-up heater 4 formed in the battery-cooling-water tank 3. At this time, the channel of battery cooling water is set up by the three-way-type control valve 7 bypass the battery-cooling-water condensator 2 so that the heat of the battery cooling water by which temperature up was carried out may not be missed.
[0019]
In drawing 7, 60 shows the opening and closing valve of the city water supplied according to the amount of the warm water used in the user hot water supply port 16, in order that 80 may maintain the battery-cooling-water circulatory system and 60a to a battery-cooling-water bypass line, and may be maintained in a hot water storage tank internal temperature water cycle system and 17 may maintain the surface level of the hot water storage tank 10 within the limits of predetermined.
[0020]
[Problem(s) to be Solved by the Invention]
By the way, there were the following problems in the above small capacity polymer electrolyte fuel cell power plants.
[0021]
As mentioned above, since the installation to a home or a small-scale place of business is assumed, a small capacity polymer electrolyte fuel cell power plant at midnight etc. when the electricity demand of an installation place becomes very small. It is possible to raise economical efficiency by performing what is called daily start and stop operation (DSS operation) that suspends a power plant, and doubles and starts timing at the time of the increase in electricity demand of the next morning.
[0022]

However, the procedure to which temperature up of the temperature of each part of a device is carried out to a predetermined temperature is required for starting of a power plant, before long, temperature up and the means to circulate are taken by the temperature up of a fuel cell body in fuel cell cooling water, and the electric heater is used for temperature up. For this reason, what is called starting electric power is consumed until a fuel cell power plant results in power generation, and there is a problem by which economical efficiency will be spoiled at this rate.

[0023]

It was made in order to cancel the above-mentioned problem, and SUBJECT of this invention controls the power consumption at the time of starting, and providing a fuel cell power plant with high economical efficiency and its operating method has this invention.

[0024]

[Means for Solving the Problem]

In an operating method of a fuel cell power plant with which this invention supplies waste heat of a fuel cell to a hot water storage tank as equipment for a waste heat management via battery cooling water in order to solve above-mentioned SUBJECT, Suppose that a part of thermal energy of supply heat required at the time of starting of said fuel cell stored in said hot water storage tank in part at least is exploited (invention of Claim 1).

[0025]

As an embodiment of an invention of said Claim 1, an invention of Claims 2-3 is preferred. That is, in the operating method according to claim 1, supply of thermal energy stored in said hot water storage tank is performed by carrying out conduction of the warm water of a hot water storage tank internal temperature water cycle system to a battery-cooling-water condensator formed in the battery-cooling-water circulatory system (invention of Claim 2).

[0026]

In said operating method according to claim 2, detected water temperature of a prescribed position of said hot water storage tank internal temperature water cycle system, When it is when lower than detected water temperature of a prescribed position within the battery-cooling-water circulatory system and supply heat required at the time of starting of said fuel cell runs short, A battery-cooling-water temperature-up heater formed in reboiling ****** or the battery-cooling-water circulatory system of gas with which said hot water storage tank is provided is worked, and thermal energy is supplied (invention of Claim 3).

[0027]

It is as follows when a operation effect of an invention of said Claims 1-3 is described in the gross. If a fuel cell power plant stops in said DSS operation, although a temperature level will fall to the outdoor-air-temperature neighborhood early comparatively by heat dissipation, small [capacity] the small battery-cooling-water tank 3 and the fuel cell body 1 of calorific capacity, The hot water storage tank 10 has large capacity, and since heat insulating construction is performed enough, it is possible to maintain an elevated temperature till the next morning. Therefore, when temperature up of the battery cooling water is carried out to near the temperature level of the hot water storage tank 10 via the battery-cooling-water condensator 2 and the temperature does not result in a predetermined temperature suitable for operation of the fuel cell body 1 at the time of starting, A starting method which heats or ****** further with the battery-cooling-water temperature-up heater 4 enables it to delete the battery-cooling-water temperature-up heater 4.

[0028]

As a device for enforcing said operating method, an invention of the following Claims 4-7 is preferred. Namely, a fuel cell body and the battery-cooling-water circulatory system which cools a fuel cell body, A hot water storage tank and a hot water storage tank internal temperature water cycle system as equipment for a waste heat management of a fuel cell body, A battery-cooling-water condensator which it was provided in said battery-cooling-water circulatory system, and was constituted so that warm water of said hot water storage tank internal temperature water cycle system and heat exchange were possible, A battery-cooling-water temperature-up heater and a battery-cooling-water thermometric element formed in said battery-cooling-water circulatory system, In a fuel cell power plant provided with a battery-cooling-water bypass line and a three-way-type control valve of a hot water storage tank circulating-water-temperature detector formed in said hot water

storage tank internal temperature water cycle system, and a battery-cooling-water condensator formed in said battery-cooling-water circulatory system,
At the time of starting of said fuel cell body, when a detection value of said hot water storage tank circulating-water-temperature detector is higher than a detection value of said battery-cooling-water thermometric element, Control said three-way-type control valve to carry out conduction of the battery cooling water to a battery-cooling-water condensator, and when low, When said three-way-type control valve is controlled to switch battery cooling water to a battery-cooling-water bypass line, and it is when [said] low and supply heat required at the time of starting of a fuel cell runs short, Said battery-cooling-water temperature-up heater should be worked, and it should have an arithmetic and control unit which supplies thermal energy (invention of Claim 4).
[0029]
In the fuel cell power plant according to claim 4, said hot water storage tank internal temperature water cycle system, Equip in-and-out piping to a hot water storage tank with a three-way-type selector valve, respectively, and said arithmetic and control unit, After carrying out conduction of the warm water of the hot water storage tank upper part to said battery-cooling-water condensator at the time of starting of said fuel cell body, After having adjusted said three-way-type selector valve so that it might flow back in the hot water storage tank lower part, and carrying out conduction of the warm water of the hot water storage tank lower part to said battery-cooling-water condensator conversely at the time of usual operation of a fuel cell, it should have a function which changes said three-way-type selector valve so that it may flow back in the hot water storage tank upper part (invention of Claim 5). This will present temperature up of battery cooling water with hot warm water in the upper layer in a hot water storage tank via a battery-cooling-water condensator, and temperature up of efficient battery cooling water becomes possible.
[0030]
In the fuel cell power plant according to claim 4 or 5, replace with said battery-cooling-water temperature-up heater, and said hot water storage tank is provided with reboiling ****** of gas, and said arithmetic and control unit, When supply heat required at the time of starting of said fuel cell body ran short, it should have a function to work reboiling ****** of said gas and to supply thermal energy (invention of Claim 6). By this, even when a temperature level of a hot water storage tank is low, it becomes possible to carry out temperature up of the battery cooling water certainly, and deletion of a battery-cooling-water temperature-up heater is attained.
[0031]
A hot water storage tank bypass line which bypasses said hot water storage tank and supplies warm water which ******(ed) by said reboiling ****** to a user hot water supply port in said fuel cell power plant according to claim 6, It should have a hot-water supply temperature control valve which it was connected to this bypass line and provided on a hot-water-supply supply line to a user hot water supply port of warm water of the hot water storage tank upper part, and a hot-water supply temperature detector formed on said hot-water-supply supply line (invention of Claim 7). In a system which did not add a new supplementary bathtub-heating function to a line of a hot water storage tank and a user hot water supply port by this but by which ** also enabled deletion of a battery-cooling-water temperature-up heater, Even when temperature of a hot water storage tank is low, it becomes possible to supply warm water of temperature which a user demanded, and it becomes possible to add convenience to a user.
[0032]
[Embodiment of the Invention]
Based on Drawings, working example of this invention is described below.
[0033]
Drawing 1 is a distribution diagram showing working example in connection with this invention, gives the same number to the member which has the same function in drawing 7, and omits that detailed explanation. The point of difference between drawing 1 and drawing 7 is a point provided with the arithmetic and control unit 70 according to claim 4 in drawing 1.
[0034]
On the time of starting of a fuel cell power plant, and in the power plant of conventional drawing 7, Since the battery-cooling-water condensator 2 is bypassed by the three-way-type control valve 7,

Even if the detection temperature of the hot water storage tank circulating-water-temperature detector 8 had exceeded the detection temperature by the battery-cooling-water thermometric element 6, using the heat of hot water storage tank circulating water for the temperature up of battery cooling water through the battery-cooling-water condensator 2 was not performed, but. In working example of drawing 1, the detection temperature of the hot water storage tank circulating-water-temperature detector 8, The calculation function which measures the detection temperature by the battery-cooling-water thermometric element 6 is added to the conventional device, While the detection temperature of the hot water storage tank circulating-water-temperature detector 8 has exceeded the detection temperature by the battery-cooling-water thermometric element 6, It becomes possible to give the heat of the hot water storage tank 10 to battery cooling water by performing control which adjusts the three-way-type control valve 7 to the battery-cooling-water condensator 2 side, and operates the hot water storage tank circulating water pump 9.

[0035]

When supply heat required at the time of starting of a fuel cell runs short, the insufficiency can be filled up with the battery-cooling-water temperature-up heater 4.

[0036]

Next, drawing 2 - drawing 4 are explained. Working example of drawing 2 shows working example in connection with Claim 5 which added the three-way-type selector valves 12A and 12B and related piping further to working example of drawing 1. Drawing 3 and drawing 4 are the figures explaining the time of usual operation of the system shown in drawing 2, respectively, and starting.

[0037]

As shown in drawing 2, to the entrance exit of the hot water storage tank 10 in the hot water storage tank internal temperature water cycle system 80 The three-way-type selector valves 12A and 12B, It has composition which forms the piping 13A and 13B which connects each three-way-type selector valves 12A and 12B and entrance exit of the hot water storage tank 10, During power-plant operation of a fuel cell, it is considered as the channel which can supply the hot warm water which is in the upper layer in the high temperature hot water and the hot water storage tank 10 which are made open and produced from the fuel cell body 1 in close and the line of 14A and 14B about the line of 13A and 13B to the user hot water supply port 16 as shown in drawing 3.

[0038]

On the other hand, the temperature up of efficient battery cooling water becomes possible by presenting the temperature up of battery cooling water with the hot warm water which makes the line of 13A and 13B close, and is in the upper layer in the hot water storage tank 10 about open and the line of 14A and 14B in it via the battery-cooling-water condensator 2 as shown in drawing 4 at the time of starting of a fuel cell power plant.

[0039]

Next, drawing 5 is explained. Working example of drawing 5 shows working example in connection with Claim 6 which added reboiling ****** 30 of gas further to working example of drawing 2. Like drawing 5, when the supplementary bathtub-heating function by gas is added, even when the temperature level of the hot water storage tank 10 is low, it becomes possible to carry out temperature up of the battery cooling water certainly, and deletion of the battery-cooling-water temperature-up heater 4 is attained.

[0040]

By adding the hot water storage tank bypass line 31 and the hot-water supply temperature control valve 32, and the hot-water supply temperature detector 33, as shown in working example of drawing 6 in connection with Claim 7, In the system which did not add a new supplementary bathtub-heating function to the line of the hot water storage tank 10 and the user hot water supply port 16 but by which ** also enabled deletion of the battery-cooling-water temperature-up heater 4, even when the temperature of the hot water storage tank 10 is low, it becomes possible to supply the warm water of the temperature which a user needs.

[0041]

[Effect of the Invention]

In the operating method of the fuel cell power plant which supplies the waste heat of a fuel cell to the hot water storage tank as equipment for a waste heat management via battery cooling water

according to [above-mentioned passage] this invention,
Since a part of thermal energy of supply heat required at the time of starting of said fuel cell stored in said hot water storage tank in part at least is exploited,
The power consumption at the time of starting can be controlled, and a fuel cell power plant with high economical efficiency and its operating method can be provided.
[Brief Description of the Drawings]
[Drawing 1]The distribution diagram showing working example of the fuel cell power plant of this invention
[Drawing 2]The distribution diagram showing working example of the fuel cell power plant with which these inventions differ
[Drawing 3]The figure explaining the time of usual operation of the device shown in drawing 2
[Drawing 4]The figure explaining the time of starting of the device shown in drawing 2
[Drawing 5]The distribution diagram showing working example of a further different fuel cell power plant of this invention
[Drawing 6]The distribution diagram showing working example of a further different fuel cell power plant of this invention
[Drawing 7]The distribution diagram showing an example of the conventional fuel cell power plant
[Drawing 8]The distribution diagram in which drawing 7 of the conventional fuel cell power plant shows a different example
[Description of Notations]
A fuel cell body, 2:battery-cooling-water condensator, 3 : 1: A battery-cooling-water tank, A battery-cooling-water temperature-up heater, 6:battery-cooling-water thermometric element, 8 : 4: A hot water storage tank circulating-water-temperature detector, A hot water storage tank, 12A, a 12B:three-way-type selector valve, 16 : 10: A user hot water supply port, 30: Reboiling ******, 31:hot water storage tank bypass line, 32:temperature-of-stored-hot-water degree control valve, 33:temperature-of-stored-hot-water degree detector, 60:battery-cooling-water circulatory system, a 60a:battery-cooling-water bypass line, 70:arithmetic and control unit, 80 : hot water storage tank internal temperature water cycle system.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]The distribution diagram showing working example of the fuel cell power plant of this invention
[Drawing 2]The distribution diagram showing working example of the fuel cell power plant with which these inventions differ
[Drawing 3]The figure explaining the time of usual operation of the device shown in drawing 2
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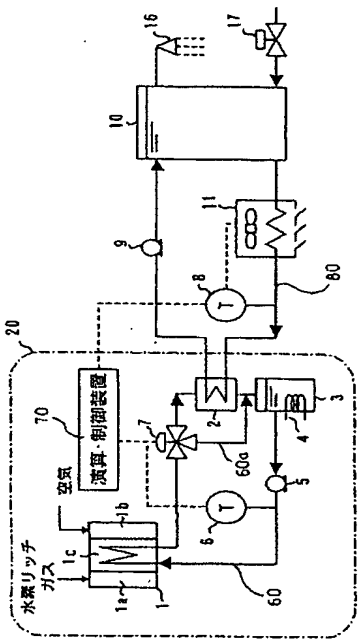
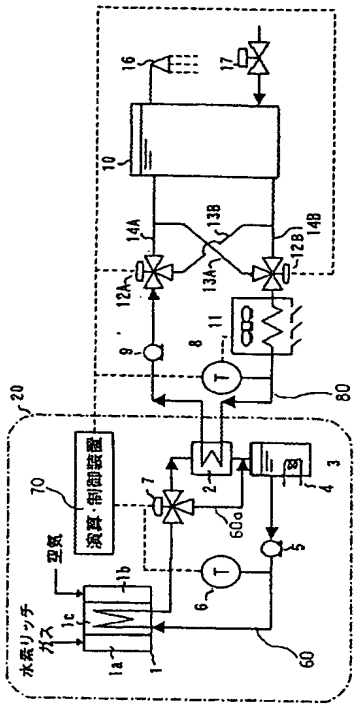
* NOTICES *

DRAWINGS

[Drawing 1]



[Drawing 2]



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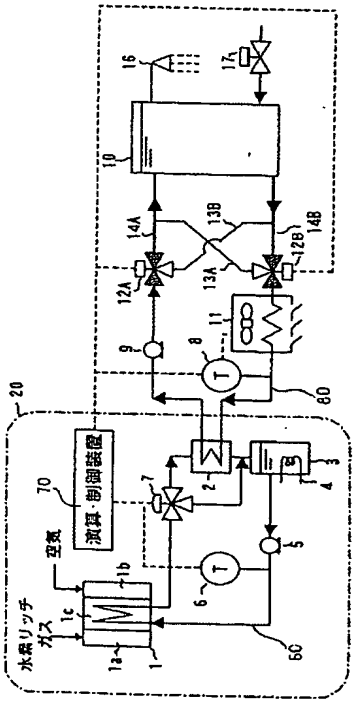

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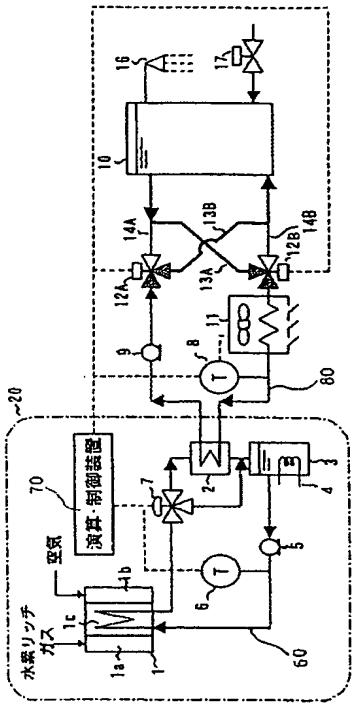

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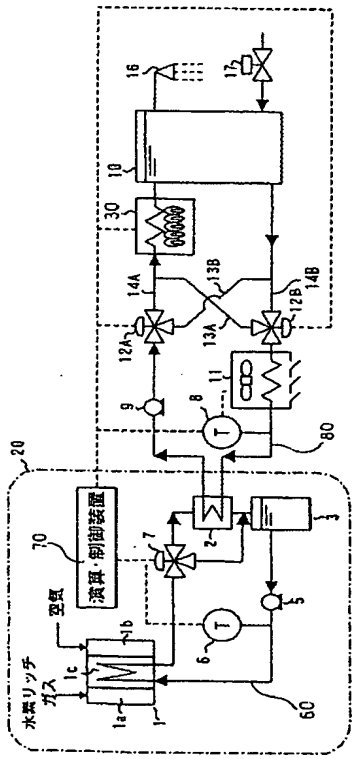

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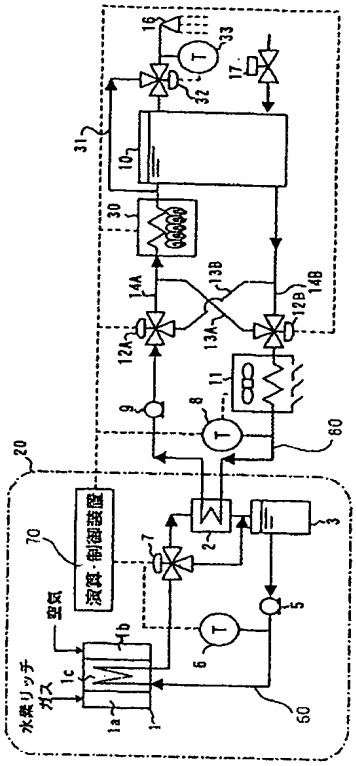

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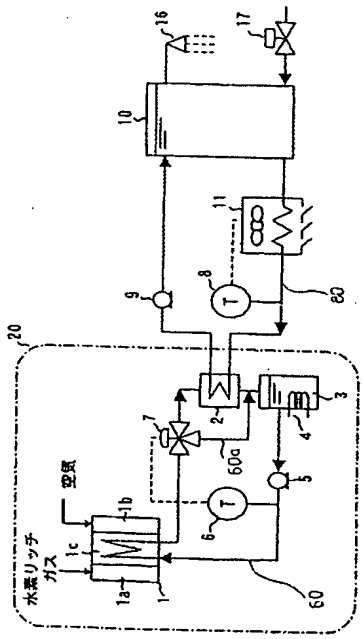

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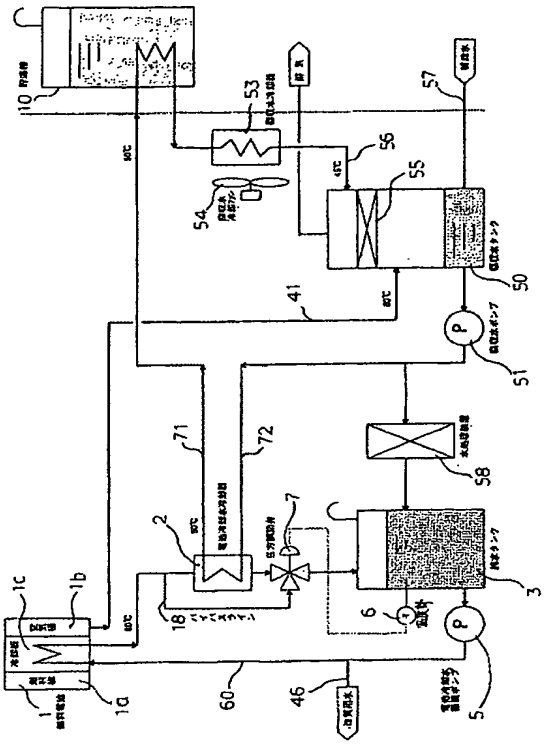

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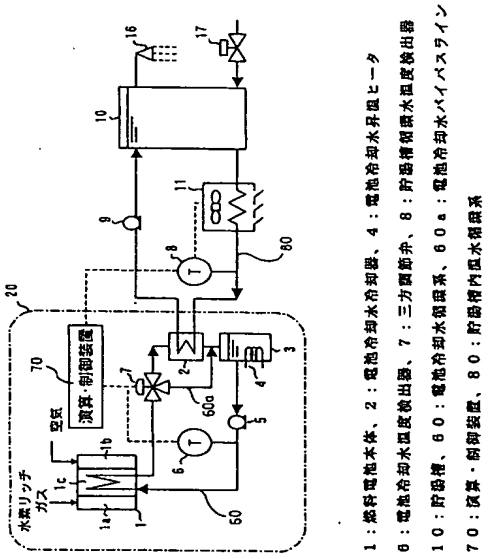
(54)【発明の名称】燃料電池発電装置とその運転方法

(57)【要約】
【課題】起動時における電力消費を抑制し、経済性の高い燃料電池発電装置とその運転方法を提供する。
【解決手段】燃料電池の廃熱を貯湯槽１０に供給する燃料電池発電装置の運転方法において、燃料電池の起動時に必要な供給熱の少なくとも一部に、貯湯槽に貯えられた熱エネルギーの一部を利用する。本方法を実施するため、燃料電池本体１の起動時に、貯湯槽循環水温度検出器８の検出値が、電池冷却水温度検出器６の検出値より高い場合は、電池冷却水を電池冷却水冷却器２に通流するように三方調節弁７を制御し、低い場合は、電池冷却水を電池冷却水バイパスライン６０ａに切換えるように三方調節弁７を制御し、かつ前記低い場合であって、燃料電池の起動時に必要な供給熱が不足する場合には、電池冷却水昇温ヒータ４を稼動して、熱エネルギーの補給を行なう演算・制御装置７０を備える。
【選択図】　図１



【特許請求の範囲】
【請求項１】
燃料電池の廃熱を、電池冷却水を介して廃熱利用設備としての貯湯槽に供給する燃料電池発電装置の運転方法において、
前記燃料電池の起動時に必要な供給熱の少なくとも一部に、前記貯湯槽に貯えられた熱エネルギーの一部を利用することを特徴とする燃料電池発電装置の運転方法。
【請求項２】
請求項１記載の運転方法において、前記貯湯槽に貯えられた熱エネルギーの供給は、電池冷却水循環系に設けた電池冷却水冷却器に、貯湯槽内温水循環系の温水を通流することにより行うことを特徴とする燃料電池発電装置の運転方法。
【請求項３】
請求項２に記載の運転方法において、前記貯湯槽内温水循環系の所定位置の検出水温が、電池冷却水循環系内の所定位置の検出水温より低い場合であって、前記燃料電池の起動時に必要な供給熱が不足する場合には、前記貯湯槽が備えるガスの追炊き装置もしくは電池冷却水循環系に設けた電池冷却水昇温ヒータを稼動して、熱エネルギーの補給を行なうことを特徴とする燃料電池発電装置の運転方法。
【請求項４】
燃料電池本体と、燃料電池本体を冷却する電池冷却水循環系と、燃料電池本体の廃熱利用設備としての貯湯槽と、貯湯槽内温水循環系と、前記電池冷却水循環系に設けられ前記貯湯槽内温水循環系の温水と熱交換可能に構成した電池冷却水冷却器と、電池冷却水昇温ヒータと、前記電池冷却水循環系に設けた電池冷却水温度検出器と、前記貯湯槽内温水循環系に設けた貯湯槽循環水温度検出器と、前記電池冷却水循環系に設けた電池冷却水冷却器の電池冷却水バイパスラインおよび三方調節弁とを備えた燃料電池発電装置において、
前記燃料電池本体の起動時に、前記貯湯槽循環水温度検出器の検出値が、前記電池冷却水温度検出器の検出値より高い場合は、電池冷却水を電池冷却水冷却器に通流するように前記三方調節弁を制御し、低い場合は、電池冷却水を電池冷却水バイパスラインに切換えるように前記三方調節弁を制御し、かつ前記低い場合であって、燃料電池の起動時に必要な供給熱が不足する場合には、前記電池冷却水昇温ヒータを稼動して、熱エネルギーの補給を行なう演算・制御装置を備えたことを特徴とする燃料電池発電装置。
【請求項５】
請求項４に記載の燃料電池発電装置において、前記貯湯槽内温水循環系は、貯湯槽への出入配管にそれぞれ三方切替弁を備え、前記演算・制御装置は、前記燃料電池本体の起動時に、貯湯槽上部の温水を前記電池冷却水冷却器に通流した後、貯湯槽下部に還流するように前記三方切替弁を調節し、燃料電池の通常運転時には逆に、貯湯槽下部の温水を前記電池冷却水冷却器に通流した後、貯湯槽上部に還流するように前記三方切替弁を切替える機能を備えたことを特徴とする燃料電池発電装置。
【請求項６】
請求項４または５に記載の燃料電池発電装置において、前記電池冷却水昇温ヒータに代えて、前記貯湯槽はガスの追炊き装置を備え、前記演算・制御装置は、前記燃料電池本体の起動時に必要な供給熱が不足する場合には、前記ガスの追炊き装置を稼動して熱エネルギーの補給を行なう機能を備えたことを特徴とする燃料電池発電装置。
【請求項７】
請求項６に記載の燃料電池発電装置において、前記追炊き装置により追炊きした温水を前記貯湯槽をバイパスしてユーザ給湯口に供給する貯湯槽バイパスラインと、このバイパスラインに接続され貯湯槽上部の温水のユーザ給湯口への給湯供給ライン上に設けた給湯温度調節弁と、前記給湯供給ライン上に設けた給湯温度検出器とを備えたことを特徴とする燃料電池発電装置。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】

この発明は、燃料電池の廃熱を外部の熱利用設備へ有効に熱供給するために、燃料電池から受けた冷却水の熱を回収する廃熱利用設備としての貯湯槽を備えた燃料電池発電装置とその運転方法に関する。

【０００２】

【従来の技術】

燃料電池発電装置に組み込まれる燃料電池としては、電解質の種類、改質原料の種類等によって異なる種々のタイプがあるが、例えば、固体高分子膜を電解質として用い、その運転温度が約８０℃と比較的低いタイプの燃料電池として、固体高分子電解質型燃料電池がよく知られている。

【０００３】

この固体高分子電解質型燃料電池は、リン酸型燃料電池と同様に、メタンガス等の原燃料を水蒸気改質して得られた燃料ガス中の水素と空気中の酸素とを、燃料電池の燃料極および空気極にそれぞれ供給し、電気化学反応に基づいて発電を行うもので、固体高分子電解質型燃料電池を組み込んだ燃料電池発電装置においても、発電時に発生する熱を冷却水を供給して取り出し、燃料電池本体の温度を一定に維持すると共に、発生熱を回収して、例えば廃熱利用温水器などの廃熱利用設備により有効活用している。

【０００４】

また、原燃料を燃料ガスへ改質するに際しては、原燃料に水蒸気を加え燃料改質器で触媒により改質を促進する方法が採られているが、改質を定常的に行なうには所要の水蒸気量を定常的に補給する必要があり、水蒸気の供給装置には、これに対応した水を常時補給する必要がある。なお、使用する水は高純度の水であることが必要であり、イオン交換式の水処理装置で不純物を除去したイオン交換水が用いられるのが通例である。

【０００５】

一方、燃料電池の電気化学反応では発電生成水が生じ、また燃料改質器では吸熱反応である水蒸気改質反応を定常的に行なうための触媒加熱用の燃焼に伴い燃焼生成水が生じるが、これらの生成水は通常の水道水に比べて不純物が少なく、これらの生成水を原水として用いれば、水処理装置の負荷を軽減することができるため、回収水タンクおよび排ガス冷却器を付加して、これらの生成水を回収する方法が採られている。

【０００６】

図８は従来のこの種の廃熱利用設備を備えた固体高分子電解質型燃料電池発電装置の、主に廃熱回収系および生成水回収系に着目した基本的な系統図である。

【０００７】

図８において、模式的に示した燃料電池１は、燃料極１ａと空気極１ｂとを有する単位セルを複数個重ねる毎に冷却管または冷却溝を有する冷却板１ｃを配設，積層することにより構成されている。

【０００８】

燃料電池の冷却水としては、電池冷却水タンク３に貯液された純水が用いられ、電池冷却水循環ポンプ５により、電池冷却水循環系６０を通流して燃料電池へ供給される。燃料電池から出た冷却水は、これを冷却するために電池冷却水循環系６０に設けられた電池冷却水冷却器２とこれをバイパスするバイパスライン１８、および両者の流量割合を調節する三方調節弁７によって、所定温度、例えば７５℃に冷却維持される。この調節制御は、電池冷却水タンク３内に設けた温度計６の出力値と所定の温度設定値との差に基づいて前記三方調節弁７の開度を調節することにより行われる。

【０００９】

一方、電池冷却水冷却器２へは、燃料電池発電装置における回収水を供給して電池冷却水を冷却する。回収水タンク５０の回収水は、回収水ポンプ５１により電池冷却水冷却器２へ供給され、その後、燃料電池発電装置パッケージの外部に取り出され、廃熱利用設備としての貯湯槽１０へ供給され、ここで燃料電池の廃熱を供給して給湯等に利用する。

【００１０】

貯湯槽１０内の温水温度が十分に高く、燃料電池からの廃熱がここへ捨てきれない場合に

は、その下流にある回収水冷却器５３、回収水冷却ファン５４にて冷却する。その後、回収水は排ガス冷却器５５へと供給され、燃料電池の空気極からの排ガスと、図示しない燃料改質器からの燃焼排ガスとを、回収水に直接接触させてこれら排ガスを冷却し、生成水を回収する。４１は排空気出口配管、５６は回収水冷却器出口配管を示す。

【００１１】

また、電池冷却水循環ポンプ５の出口側には改質用の水蒸気となる純水の分岐ライン４６を設け、ここから図示しない燃料改質器へと定常的に改質用水を供給する。従って、その分は常時補給する必要があるが、これは回収水から、水処理装置５８を介して補給され、回収水が不足する場合には、補給水供給ライン５７から供給される。

【００１２】

固体高分子電解質型燃料電池の運転温度は約８０℃であるため、この温度を維持するために冷却水の燃料電池出口温度も約８０℃となる。一方、排ガスを回収し、外部からの補給水をできる限りゼロとするためには、回収水冷却器５３から出た回収水の温度を４５℃以下に下げる必要があるため、その結果として回収水の貯湯槽入口温度は約５０℃となる。

【００１３】

次に、図７の従来システム例について述べる。図７に示すシステムは、図８に示したシステムとは一部異なる小容量固体高分子型燃料電池発電装置のシステム例を示し、この発明の説明の便宜上、一部の部材を省略して示す。なお、図７において、図８に示した部材と同一機能部材には、同一番号を付してその詳細説明を省略する。

【００１４】

近年、新エネルギー政策促進の観点から、小容量固体高分子型燃料電池発電装置の開発が急速に進展し、家庭や小規模事業所等に設置する検討が進められている。これらの設置先では，小容量固体高分子型燃料電池発電装置が電力を発生する際に付随して生じる約７０℃の温水を、貯湯槽に蓄熱し浴場や厨房に給湯するコージェネレーションを行つて、経済メリットを発生させるのが一般的である。

【００１５】

図７において２０で示した一点鎖線の範囲内は、小容量固体高分子型燃料電池発電装置のパッケージの内部を示す。パッケージ２０の内部には、部番１～７で示す部材以外にも多数の機器が存在するが、ここではこれらを省略している。

【００１６】

１は燃料電池本体を示し、前述のように、発生した熱は電池冷却水冷却器２により外部の貯湯槽１０に供給される。このとき、三方調節弁７により、電池冷却水温度検出器６による検出温度を燃料電池本体１が安定して運転できる温度になるように、電池冷却水冷却器２を通過する電池冷却水流量を適宜調節している。電池冷却水冷却器２により外部に供給された熱は、貯湯槽循環水ポンプ９により送出される貯湯槽循環水により、貯湯槽１０に蓄熱される。

【００１７】

貯湯槽１０の温度レベルが一定値以上に達したことを貯湯槽循環水温度検出器８が検知すると、貯湯槽循環水冷却器１１が作動し、燃料電池発電装置の電池冷却水温度制御が正常に行えるよう制御される。なお、貯湯槽循環水は、貯湯槽１０の下部より導出され、電池冷却水冷却器２により加熱された後、貯湯槽上部に供給される配管構成となっている。これは、貯湯槽１０内部の自然対流による温水の温度分布、すなわち貯湯槽１０内の上層部の温度レベルが高いことを考慮し、貯湯槽の温水を使用するユーザ給湯口１６に可能な限り高いレベルの温度を供給するためである。

【００１８】

一方、燃料電池発電装置が発電に至るまでの起動工程時は、発電開始に備え、燃料電池本体１の温度を所定の温度まで昇温するために、電池冷却水タンク３に設けられた電池冷却水昇温ヒータ４により、電池冷却水が加熱される。このとき、昇温された電池冷却水の熱を逃さないように、電池冷却水の流路は、三方調節弁７によって、電池冷却水冷却器２をバイパスするよう設定される。

【００１９】
なお、図７において、６０は電池冷却水循環系、６０ａは電池冷却水バイパスライン、８０は貯湯槽内温水循環系、１７は貯湯槽１０の液面レベルを所定の範囲内に維持するために、ユーザ給湯口１６での温水使用量に応じて供給される市水の開閉弁を示す。
【００２０】
【発明が解決しようとする課題】
ところで、前述のような小容量固体高分子型燃料電池発電装置においては、下記のような問題点があった。
【００２１】
小容量固体高分子型燃料電池発電装置は、前述のように、家庭や小規模事業所への設置が想定されるため、設置先の電力需要が非常に小さくなる深夜等は、発電装置を停止し、翌朝の電力需要増加時にタイミングを合わせて起動させる、所謂デイリー・スタート・アンド・ストップ運転（ＤＳＳ運転）を行うことで、経済性を向上させることが考えられる。
【００２２】
しかしながら、発電装置の起動には、装置各部の温度を所定の温度まで昇温させる手順が必要であり、そのうち、燃料電池本体の昇温には燃料電池冷却水を昇温，循環させる手段が採られ、昇温には電気ヒータが用いられている。このため、燃料電池発電装置が発電に至るまでの間は、いわゆる起動電力を消費してしまい、この分、経済性が損われてしまう問題がある。
【００２３】
この発明は、上記問題点を解消するためになされたもので、この発明の課題は、起動時における電力消費を抑制し、経済性の高い燃料電池発電装置とその運転方法を提供することにある。
【００２４】
【課題を解決するための手段】
前述の課題を解決するために、この発明は、燃料電池の廃熱を、電池冷却水を介して廃熱利用設備としての貯湯槽に供給する燃料電池発電装置の運転方法において、前記燃料電池の起動時に必要な供給熱の少なくとも一部に、前記貯湯槽に貯えられた熱エネルギーの一部を利用することとする（請求項１の発明）。
【００２５】
また、前記請求項１の発明の実施態様としては、請求項２ないし３の発明が好ましい。即ち、請求項１記載の運転方法において、前記貯湯槽に貯えられた熱エネルギーの供給は、電池冷却水循環系に設けた電池冷却水冷却器に、貯湯槽内温水循環系の温水を通流することにより行う（請求項２の発明）。
【００２６】
さらに、前記請求項２に記載の運転方法において、前記貯湯槽内温水循環系の所定位置の検出水温が、電池冷却水循環系内の所定位置の検出水温より低い場合であって、前記燃料電池の起動時に必要な供給熱が不足する場合には、前記貯湯槽が備えるガスの追炊き装置もしくは電池冷却水循環系に設けた電池冷却水昇温ヒータを稼動して、熱エネルギーの補給を行なう（請求項３の発明）。
【００２７】
前記請求項１ないし３の発明の作用効果について総括的に述べると、下記のとおりである。前記ＤＳＳ運転において燃料電池発電装置が停止すると、容積の小さい、即ち、熱容量の小さい電池冷却水タンク３および燃料電池本体１は、放熱により温度レベルが比較的早く外気温度近辺まで低下してしまうが、貯湯槽１０は容積が大きく、また断熱施工が十分行われているため、翌朝まで高温を維持することが可能である。従って、起動時に、電池冷却水冷却器２を介して貯湯槽１０の温度レベル付近まで電池冷却水を昇温し、その温度が、燃料電池本体１の運転に適した所定の温度に至らない場合は、電池冷却水昇温ヒータ４でさらに加熱、もしくは追焚きする起動方法により、電池冷却水昇温ヒータ４を削除することが可能となる。

【００２８】
また、前記運転方法を実施するための装置としては、下記請求項４ないし７の発明が好適である。即ち、燃料電池本体と、燃料電池本体を冷却する電池冷却水循環系と、燃料電池本体の廃熱利用設備としての貯湯槽と、貯湯槽内温水循環系と、前記電池冷却水循環系に設けられ前記貯湯槽内温水循環系の温水と熱交換可能に構成した電池冷却水冷却器と、電池冷却水昇温ヒータと、前記電池冷却水循環系に設けた電池冷却水温度検出器と、前記貯湯槽内温水循環系に設けた貯湯槽循環水温度検出器と、前記電池冷却水循環系に設けた電池冷却水冷却器の電池冷却水バイパスラインおよび三方調節弁とを備えた燃料電池発電装置において、
前記燃料電池本体の起動時に、前記貯湯槽循環水温度検出器の検出値が、前記電池冷却水温度検出器の検出値より高い場合は、電池冷却水を電池冷却水冷却器に通流するように前記三方調節弁を制御し、低い場合は、電池冷却水を電池冷却水バイパスラインに切換えるように前記三方調節弁を制御し、かつ前記低い場合であって、燃料電池の起動時に必要な供給熱が不足する場合には、前記電池冷却水昇温ヒータを稼動して、熱エネルギーの補給を行なう演算・制御装置を備えたものとする（請求項４の発明）。
【００２９】
また、請求項４に記載の燃料電池発電装置において、前記貯湯槽内温水循環系は、貯湯槽への出入配管にそれぞれ三方切替弁を備え、前記演算・制御装置は、前記燃料電池本体の起動時に、貯湯槽上部の温水を前記電池冷却水冷却器に通流した後、貯湯槽下部に還流するように前記三方切替弁を調節し、燃料電池の通常運転時には逆に、貯湯槽下部の温水を前記電池冷却水冷却器に通流した後、貯湯槽上部に還流するように前記三方切替弁を切替える機能を備えたものとする（請求項５の発明）。これにより、貯湯槽中の上層にある高温の温水を電池冷却水冷却器を介して電池冷却水の昇温に供することとなり、効率的な電池冷却水の昇温が可能となる。
【００３０】
さらに、請求項４または５に記載の燃料電池発電装置において、前記電池冷却水昇温ヒータに代えて、前記貯湯槽はガスの追炊き装置を備え、前記演算・制御装置は、前記燃料電池本体の起動時に必要な供給熱が不足する場合には、前記ガスの追炊き装置を稼動して熱エネルギーの補給を行なう機能を備えたものとする（請求項６の発明）。これにより、貯湯槽の温度レベルが低い場合でも確実に電池冷却水を昇温させることが可能となり、また電池冷却水昇温ヒータの削除が可能となる。
【００３１】
また、前記請求項６に記載の燃料電池発電装置において、前記追炊き装置により追炊きした温水を前記貯湯槽をバイパスしてユーザ給湯口に供給する貯湯槽バイパスラインと、このバイパスラインに接続され貯湯槽上部の温水のユーザ給湯口への給湯供給ライン上に設けた給湯温度調節弁と、前記給湯供給ライン上に設けた給湯温度検出器とを備えたものとする（請求項７の発明）。これにより、貯湯槽とユーザ給湯口のラインに新たな追焚き機能を付加せずとも、電池冷却水昇温ヒータの削除を可能としたシステムにおいて、貯湯槽の温度が低い場合でもユーザーの要求した温度の温水を供給することが可能となり、ユーザーに対する利便性を付加することが可能となる。
【００３２】
【発明の実施の形態】
図面に基づき、本発明の実施例について以下にのべる。
【００３３】
図１は、この発明に関わる実施例を示す系統図であり、図７において同じ機能を有する部材には同一の番号を付してその詳細説明を省略する。図１と図７との相違点は、図１においては、請求項４に記載の演算・制御装置７０を備える点である。
【００３４】
燃料電池発電装置の起動時において、従来の図７の発電装置においては、三方調節弁７によって電池冷却水冷却器２がバイパスされているため、貯湯槽循環水温度検出器８の検出

温度が、電池冷却水温度検出器６による検出温度を上回っていても、貯湯槽循環水の熱を電池冷却水冷却器２を通じて電池冷却水の昇温に用いることは行われていなかったが、図１の実施例においては、貯湯槽循環水温度検出器８の検出温度と、電池冷却水温度検出器６による検出温度を比較する演算機能を従来の装置に付加し、また、貯湯槽循環水温度検出器８の検出温度が、電池冷却水温度検出器６による検出温度を上回っている間は、三方調節弁７を電池冷却水冷却器２の側に調節し、かつ、貯湯槽循環水ポンプ９を作動させる制御を行うことにより、貯湯槽１０の熱を電池冷却水に与えることが可能となる。

【００３５】

さらに、燃料電池の起動時に必要な供給熱が不足する場合には、電池冷却水昇温ヒータ４により、その不足分を補充することができる。

【００３６】

次に、図２～図４について説明する。図２の実施例は、図１の実施例に対してさらに三方切替弁１２Ａ，１２Ｂおよび関連配管を追加した請求項５に関わる実施例を示す。また、図３および図４は、それぞれ図２に示すシステムの通常運転時および起動時を説明する図である。

【００３７】

図２に示すように、貯湯槽内温水循環系８０における貯湯槽１０の入口出口に三方切替弁１２Ａ，１２Ｂと、それぞれの三方切替弁１２Ａ，１２Ｂと貯湯槽１０の入口出口とを結ぶ配管１３Ａ，１３Ｂとを設ける構成とし、燃料電池の発電装置運転中は図３に示すとおり、１３Ａ，１３Ｂのラインを閉、１４Ａ，１４Ｂのラインを開とし、燃料電池本体１から生じる高温水および貯湯槽１０中の上層にある高温の温水をユーザ給湯口１６へ供給することが可能な流路とする。

【００３８】

一方、燃料電池発電装置の起動時には、図４に示すとおり、１３Ａ，１３Ｂのラインを開、１４Ａ，１４Ｂのラインを閉とし、貯湯槽１０中の上層にある高温の温水を電池冷却水冷却器２を介して電池冷却水の昇温に供することで、効率的な電池冷却水の昇温が可能となる。

【００３９】

次に、図５について説明する。図５の実施例は、図２の実施例に対してさらにガスの追炊き装置３０を追加した請求項６に関わる実施例を示す。図５のように、ガスによる追焚き機能を付加した場合には、貯湯槽１０の温度レベルが低い場合でも確実に電池冷却水を昇温させることが可能となり、また、電池冷却水昇温ヒータ４の削除が可能となる。

【００４０】

さらに、請求項７に関わる図６の実施例に示すように、貯湯槽バイパスライン３１および給湯温度調節弁３２と給湯温度検出器３３を追加することにより、貯湯槽１０とユーザ給湯口１６のラインに新たな追焚き機能を付加せずとも、電池冷却水昇温ヒータ４の削除を可能としたシステムにおいて、貯湯槽１０の温度が低い場合でもユーザが必要とする温度の温水を供給することが可能となる。

【００４１】

【発明の効果】

上記のとおり、この発明によれば、燃料電池の廃熱を、電池冷却水を介して廃熱利用設備としての貯湯槽に供給する燃料電池発電装置の運転方法において、
前記燃料電池の起動時に必要な供給熱の少なくとも一部に、前記貯湯槽に貯えられた熱エネルギーの一部を利用することとしたので、
起動時における電力消費を抑制し、経済性の高い燃料電池発電装置とその運転方法を提供することができる。

【図面の簡単な説明】

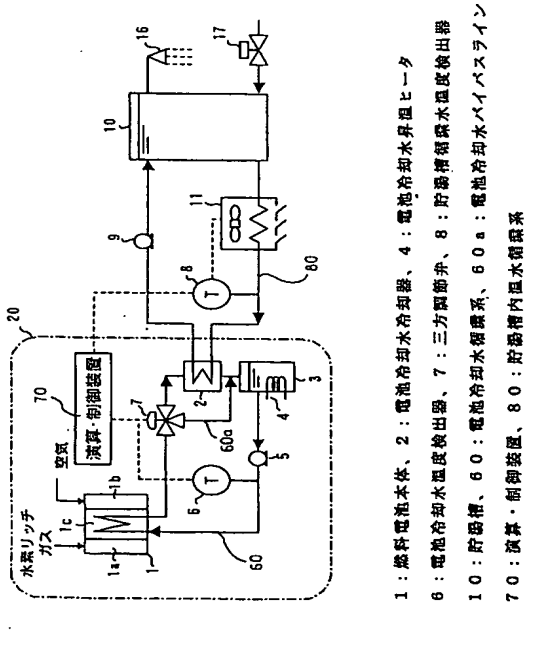
【図１】この発明の燃料電池発電装置の実施例を示す系統図

【図２】この発明の異なる燃料電池発電装置の実施例を示す系統図

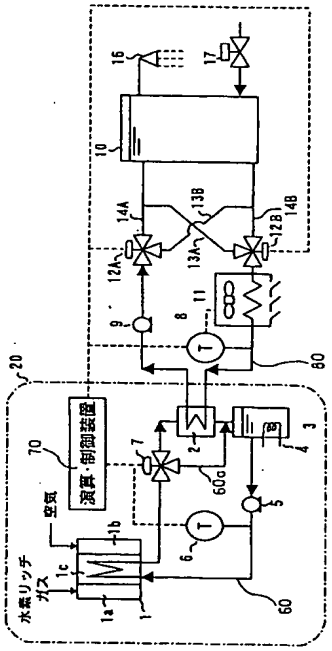
【図３】図２に示す装置の通常運転時を説明する図

【図４】図２に示す装置の起動時を説明する図
【図５】この発明のさらに異なる燃料電池発電装置の実施例を示す系統図
【図６】この発明のさらに異なる燃料電池発電装置の実施例を示す系統図
【図７】従来の燃料電池発電装置の一例を示す系統図
【図８】従来の燃料電池発電装置の図７とは異なる例を示す系統図
【符号の説明】
１：燃料電池本体、２：電池冷却水冷却器、３：電池冷却水タンク、４：電池冷却水昇温ヒータ、６：電池冷却水温度検出器、８：貯湯槽循環水温度検出器、１０：貯湯槽、１２Ａ，１２Ｂ：三方切替弁、１６：ユーザ給湯口、３０：追炊き装置、３１：貯湯槽バイパスライン、３２：貯湯温度調節弁、３３：貯湯温度検出器、６０：電池冷却水循環系、６０ａ：電池冷却水バイパスライン、７０：演算・制御装置、８０：貯湯槽内温水循環系。

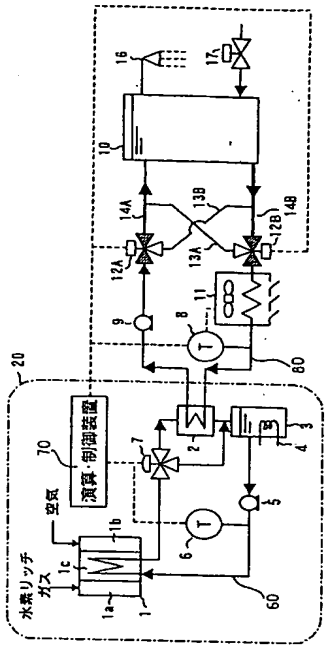
【図１】



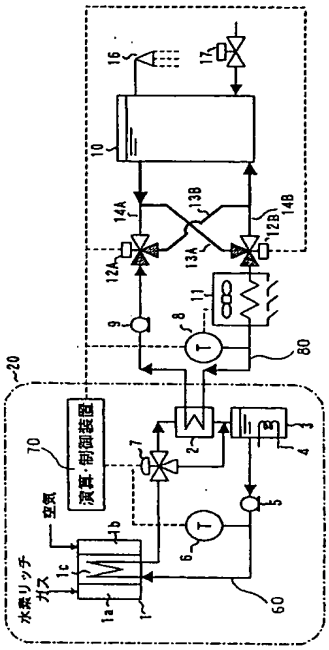
【図２】



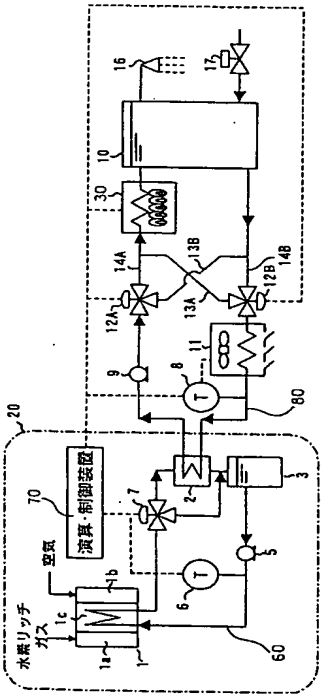
【図３】


演算・制御装置
空気
水素リッチガス

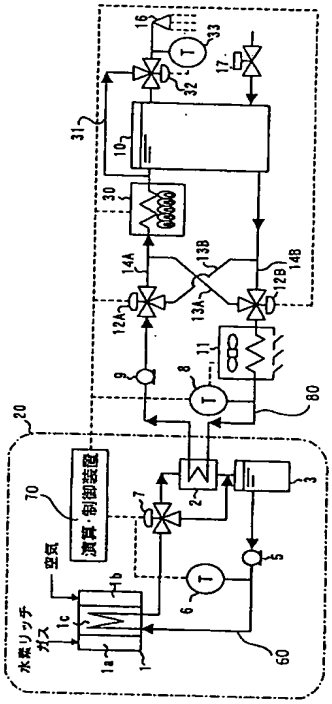
【図４】


演算・制御装置
空気
水素リッチガス

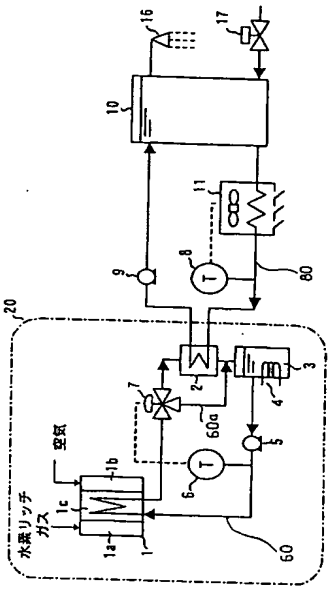
【図５】


演算・制御装置
空気
水素リッチガス

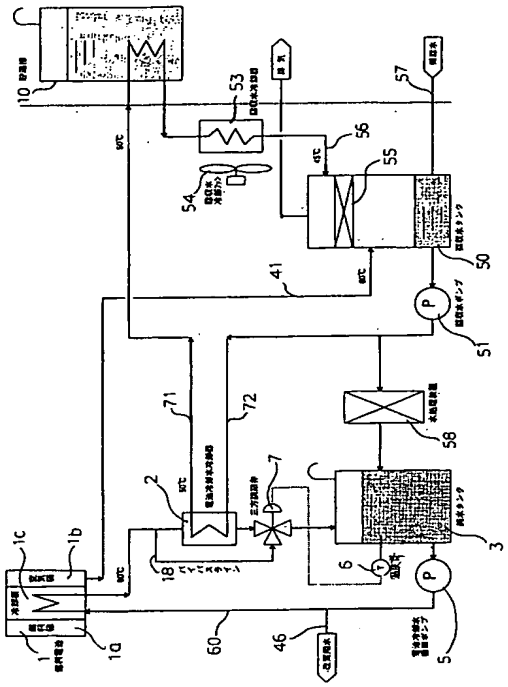
【図６】


演算・制御装置
空気
水素リッチガス

【図７】


16
17
10
11
8
9
80
20
7
2
3
4
60a
5
空気
6
1b
1c
水素リッチガス
1a
1
60

【図８】


10
53
57
56
55
54
50
41
51
71
72
58
2
7
3
18
6
1c
1b
1a
60
46
5